

Use of Biowin for Process Troubleshooting / Design for a Unique Wastewater

OWEA Plant Operations and Lab Analysis Workshop

W. James Gellner

HAZEN AND SAWYER
Environmental Engineers & Scientists



Outline

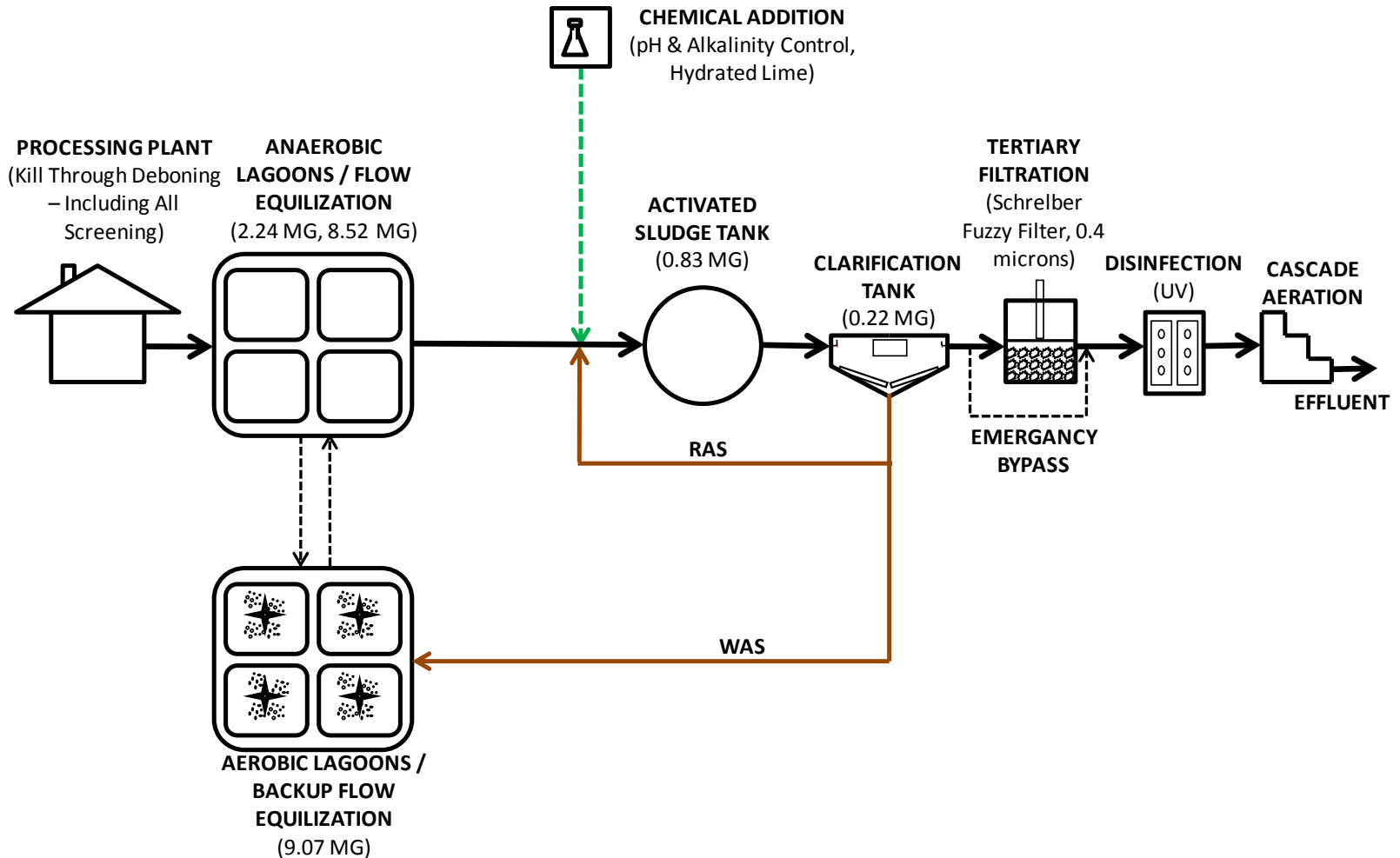
- **Introduction / Problem Overview**
 - Plant Issues
 - Biowin Overview
- **Special Sampling**
- **Simulations for Plant Troubleshooting**
- **Simulations for Upgrade Design**
- **Summary / Conclusions**

Plant Overview

- Turkey processing plant
- 37,000 turkeys per day
- Direct discharge permit
- Repeated ammonia and solids violations led to IDEM Agreed Order
- ATS hired to perform CPE



Plant Schematic



Effluent Requirements

Parameter	30 Day Concentration (mg/l)	Daily Concentration (mg/l)
BOD ₅	20	30
Total Suspended Solids	20	30
Ammonia (summer)	0.93	1.85
Ammonia (winter)	1.77	3.54
Oil and Grease	10	15
E coli	125/100 mls	235/100 mls
pH	> 6.0 S.U. and < 9.0 S.U.	
Dissolved Oxygen	> 6 mg/l winter > 5 mg/l summer	

Influent Loadings

Parameter	Average	Daily Maximum
Flow	0.61 MGD	1.20 MGD
BOD5	3860 lb/day (760 mg/l)	8060 lb/day
COD	8190 lb/day (1610 mg/l)	13300 lb/day
TSS	1120 lb/day (220 mg/l)	2070lb/day
NH3	790 lb/day (155 mg/l)	1620 lb/day
Alkalinity	3120 lb/day (610 mg/l)	5280 lb/day

ATS / Hazen and Sawyer

- 11/2008
- CPE / Process Evaluation
 - Detailed sampling & analysis
- DAF implementation
- Design of improvements

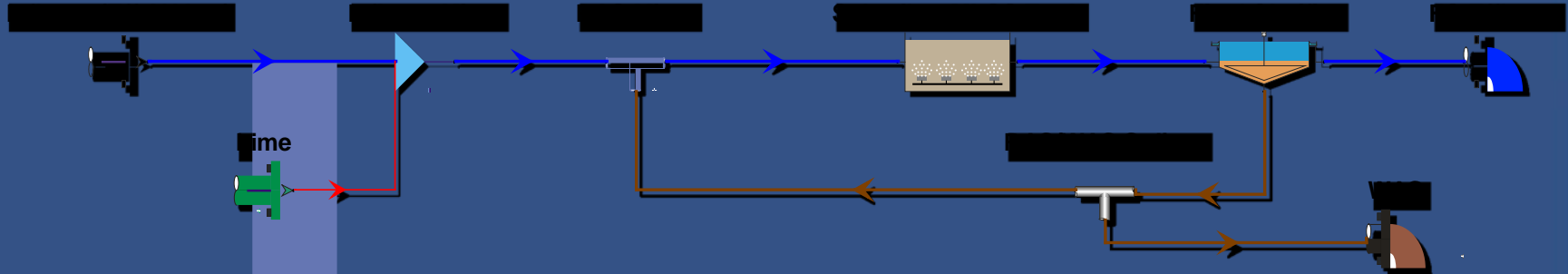


Ammonia / Solids Violations

- Repeated (inconsistent operations)
- Overwasting of biological solids
- Lagoon solids slugs
- Overfeed of lime to biological system
- Poor settling – filaments
- “FLIP!”



BioWin Overview



- Full plant simulation software

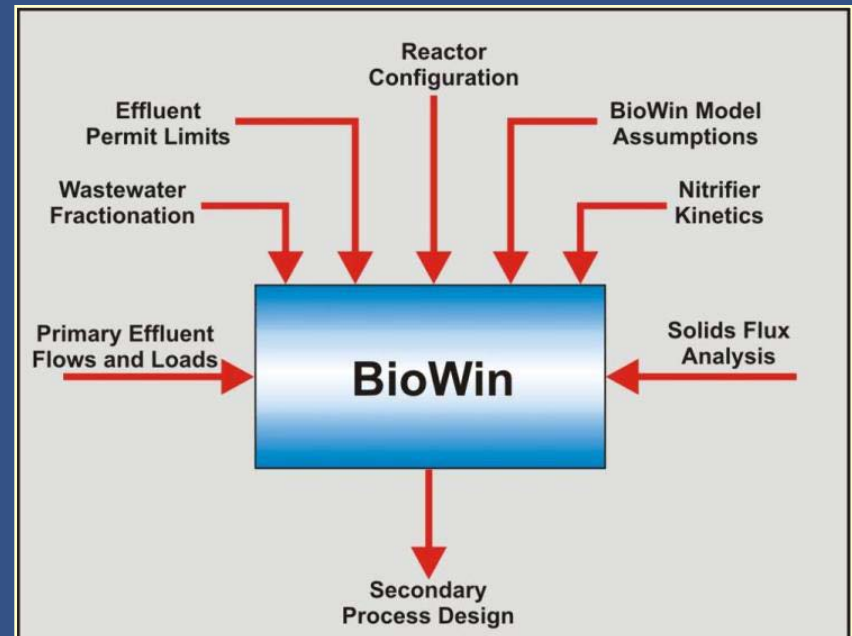
ge/Anaerobic

Digestion (IWA)

- Graphical user interface
 - User friendly, Windows style
- Requires detailed characterization

BioWin Overview (cont)

- **Steady state / dynamic simulations**
- **Tailored to domestic waste**
- **Ability to import/export data**
- **Allows multiple simulations for what-if and process sizing analysis**



Why Use Biowin?

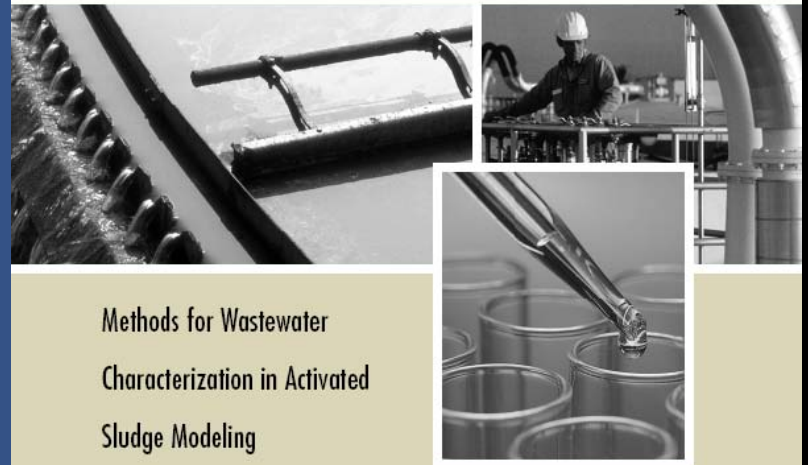
- **Process troubleshooting tool**
 - Evaluate effect of solids on system performance
- **Operations staff education**
 - Simulations provide good examples for operations staff
- **Design tool**
 - Size / optimize new processes for improvements

Special Sampling

- Characterize influent
- Capture process conditions
- Allow for accurate representation of process performance

WATER ENVIRONMENT
RESEARCH FOUNDATION

Treatment Processes and Systems



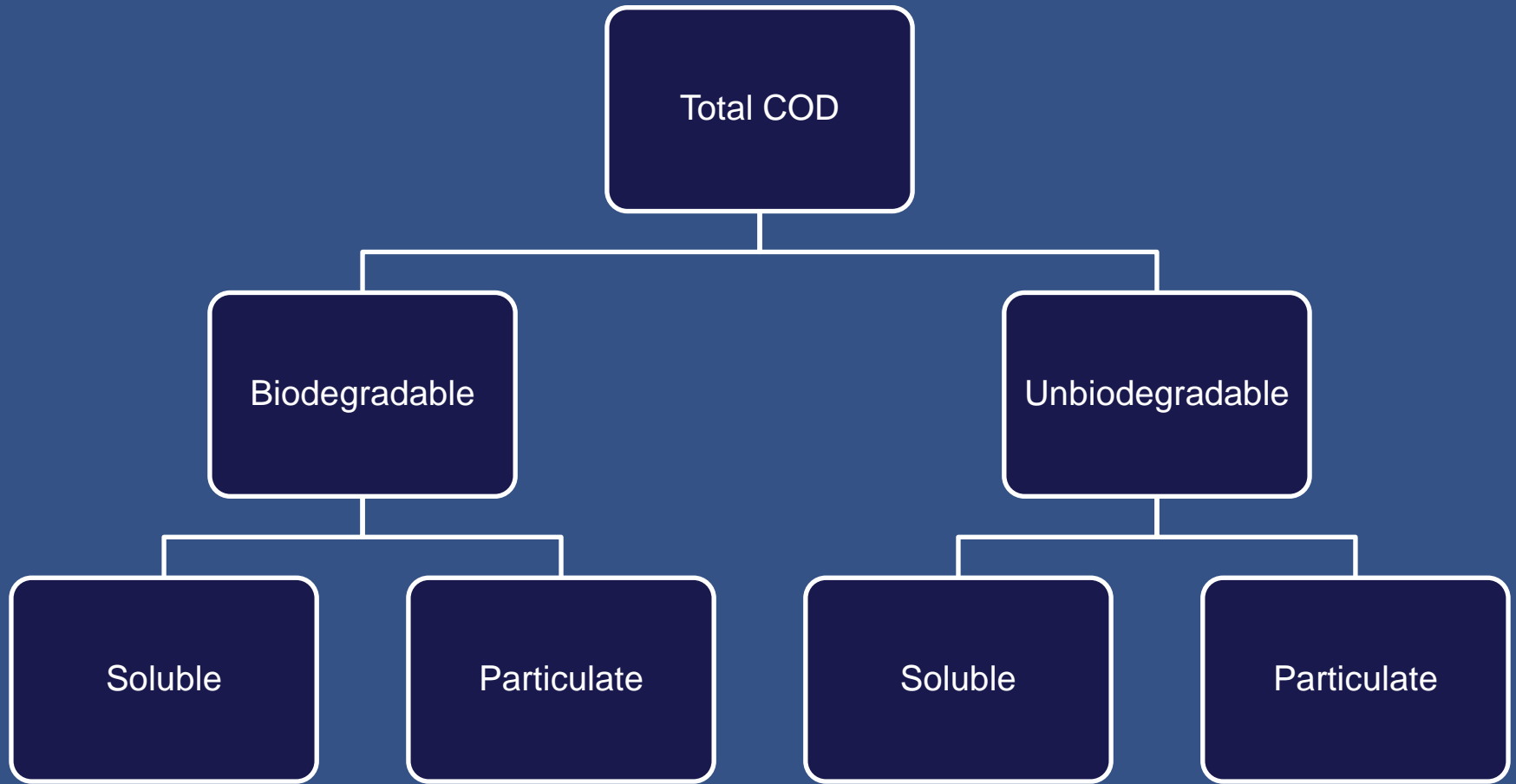
Methods for Wastewater
Characterization in Activated
Sludge Modeling

Co-published by

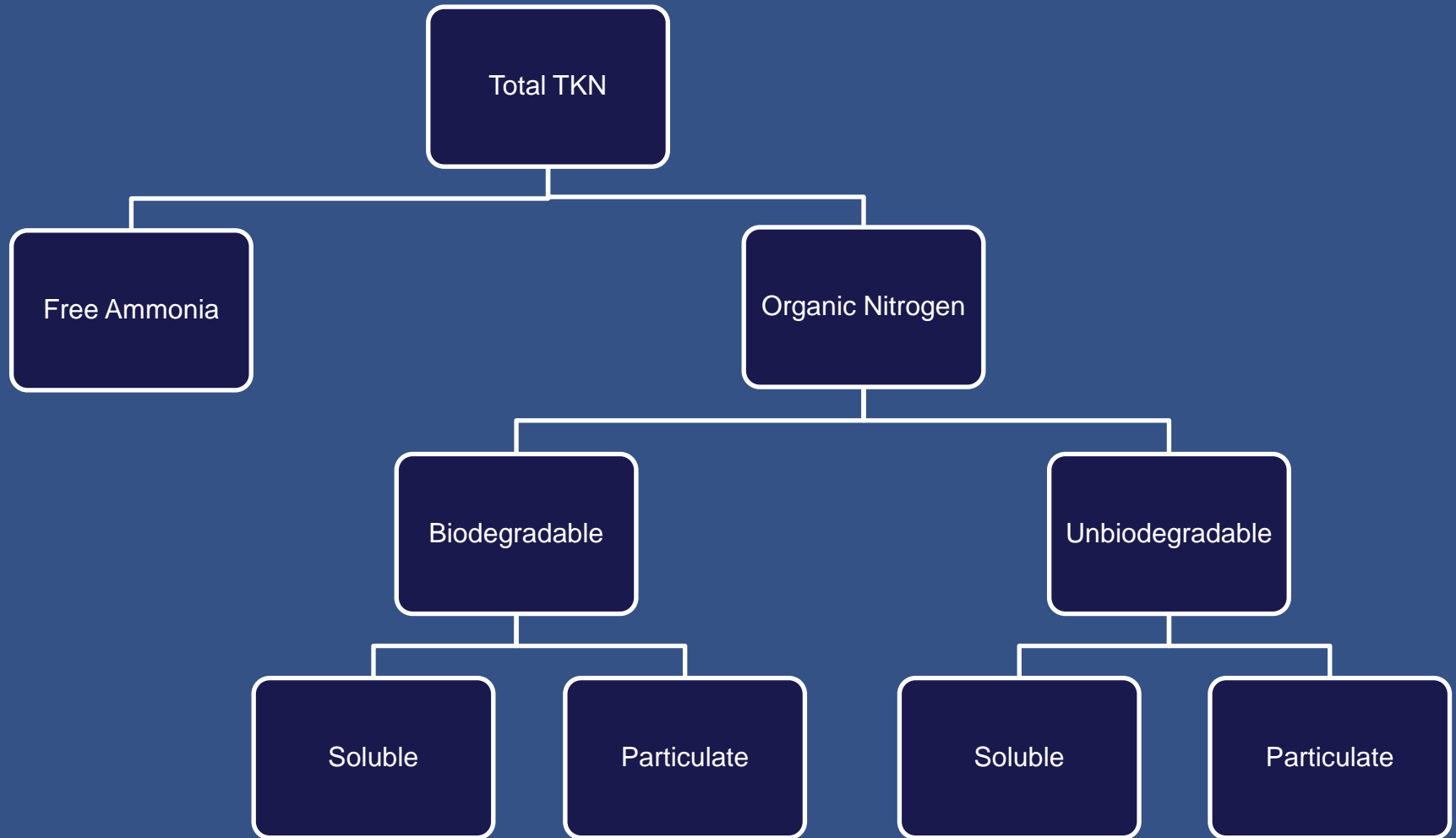
IWA
Publishing

Water Environment
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the Global Water Environment

COD Components



TKN Components



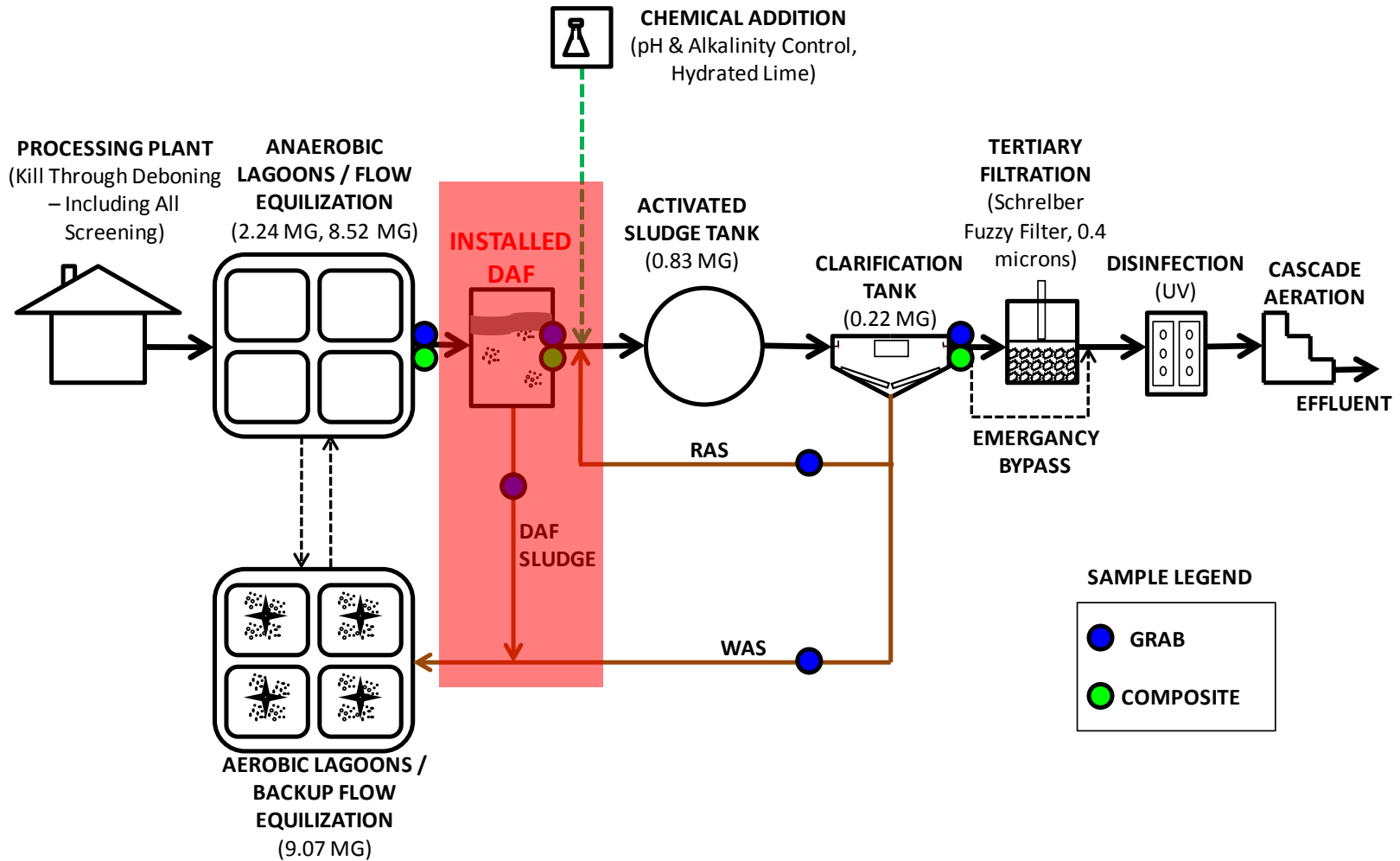
“The Filtration Tree”

Symbol	Filter	Representation
XX	Not filtered	Represents total sample (with particulate and soluble)
XG	Glass fiber – 1.5 micron	Traditional breakpoint between particulate and soluble
XM	Membrane filter – 0.45 micron	Difference between XM and XG represents colloidal
XF	Flocculated / filtered with 0.45 micron	Used to estimate readily biodegradable material (COD)

Special Sampling Overview

- **3 days for each event**
- **Composite sampling**
- **Process grabs at 9am and 9pm**
- **Total of ~ 400 samples and analysis**
- **Special sampling performed in June (prior to DAF) and in September 2009 (after temp DAF installation)**

Sampling Schematic



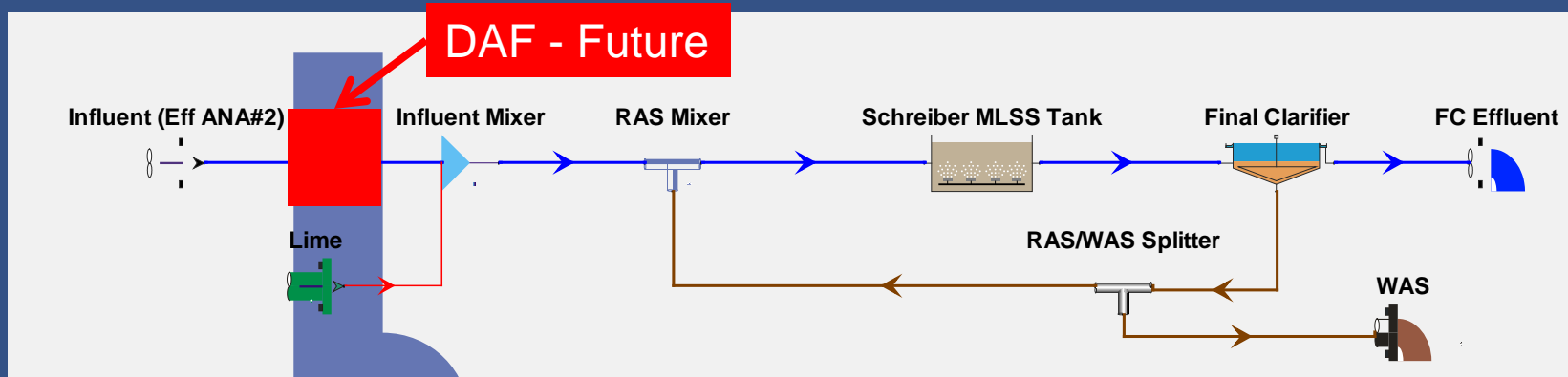
Special Sampling Results

Constituent	1 st Sampling Event Unfiltered (mg/l)	2 nd Sampling Event Unfiltered (mg/l)
TSS	165	154
COD	1513	1294
BOD ₅	623	520
CBOD ₅	529	421
TKN	221	234
NH ₃	129	183
NO _x N	0.5	0.43
NO ₂ N	0	0.05
TP	34.8	36.6
PO ₄ P	10.4	11.7
Ca ⁺²	28.4	91.1
Mg ⁺²	10.3	13.8

Influent Fractions

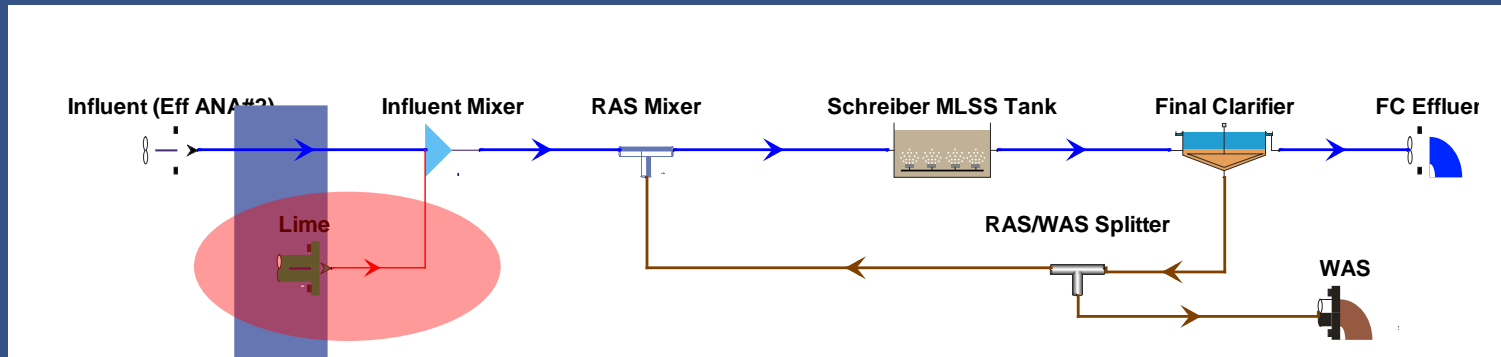
	Default	1 st event	2 nd event
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total]	0.27	0.560	0.515
Fac - Acetate [gCOD/g of readily biodegradable]	0.15	0.000	0
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable]	0.5	0.150	0.27
Fus - Unbiodegradable soluble [gCOD/g of total]	0.08	0.083	0.058
Fup - Unbiodegradable particulate [gCOD/g of total]	0.13	0.283	0.29
Fna - Ammonia [gNH ₃ -N/gTKN]	0.75	0.582	0.606
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5	0.250	0.25
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.02	0.020	0.02
FupN - N: ratio for unbiodegradable part. [gN/gCOD]	0.035	0.035	0.035
Fpo4 - Phosphate [gPO ₄ -P/gTP]	0.75	0.297	0.32
FupP - P: ratio for influent unbiodegradable part. [gP/gCOD]	0.011	0.560	0.515

Biowin Setup



- June 2009 data used for troubleshooting
- September 2009 data used for process sizing

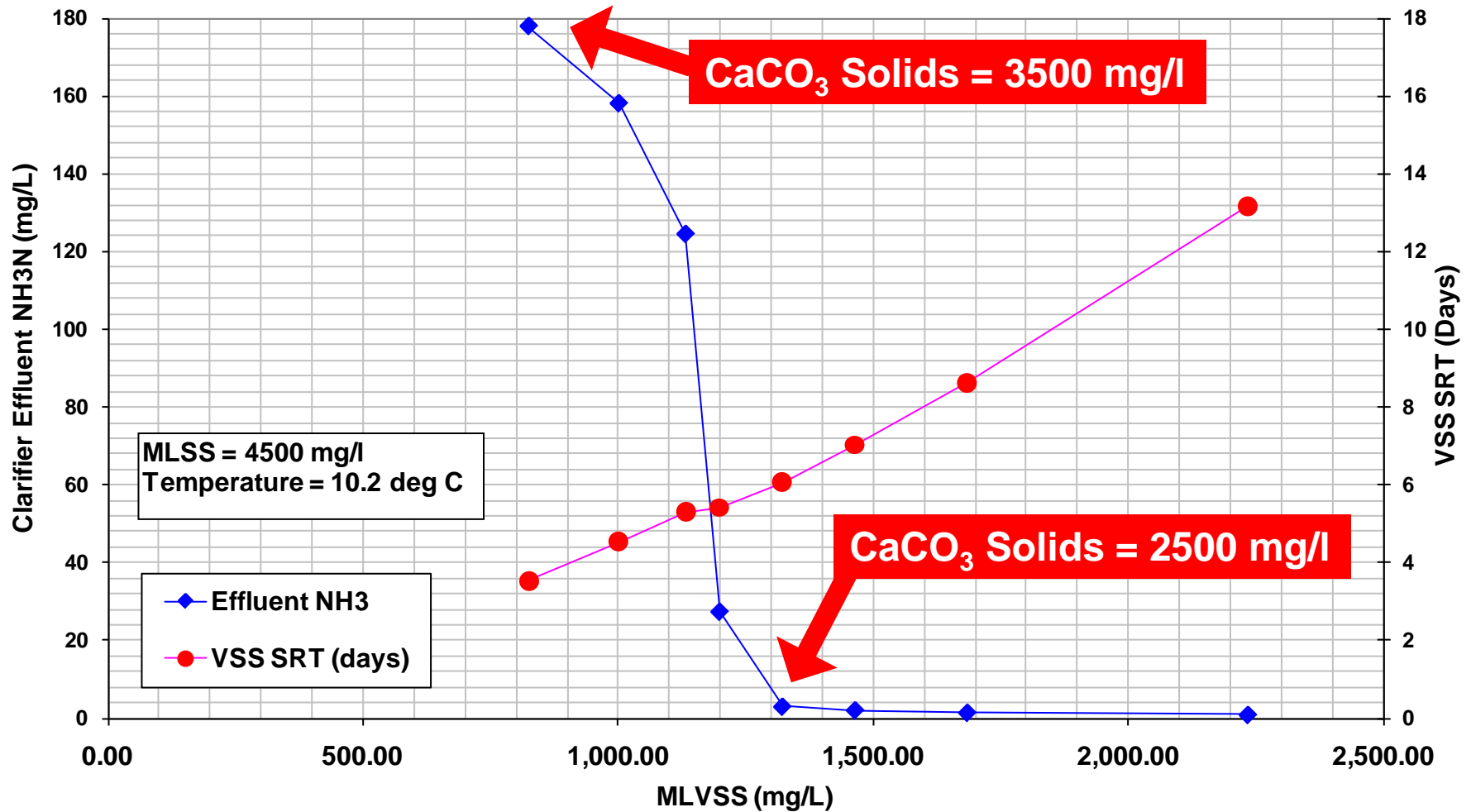
“Lime Solids” Scenarios



increase CaCO_3 solids in reactor

- CaCO_3 model
- pH modeling turned off to accommodate precipitate model

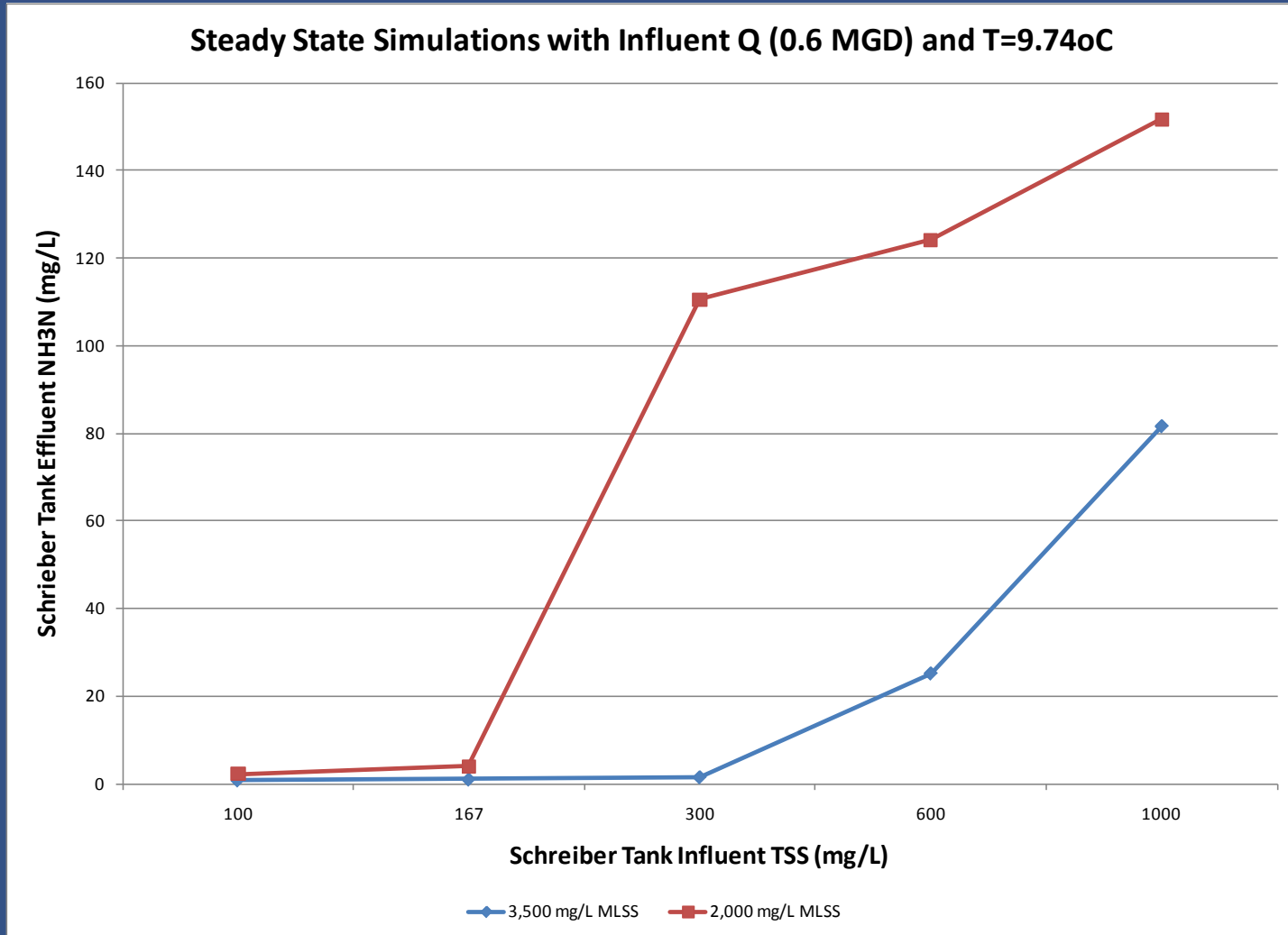
“Lime Solids” Results



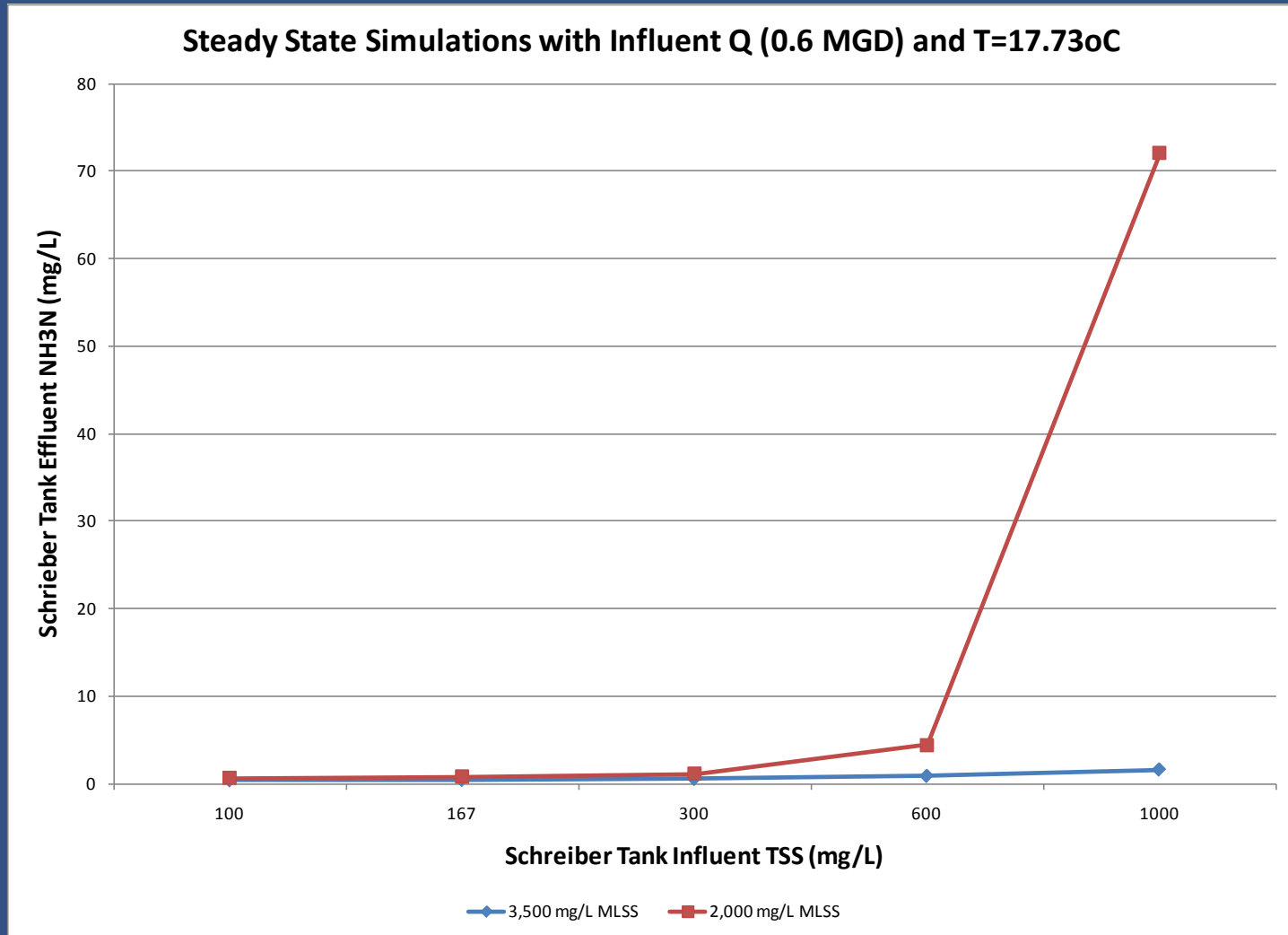
“Lagoon Solids” Scenarios

- **Influent solids of 100, 160, 300, 600, 1000**
 - **Ratio'd solids in influent fractions & COD**
- **MLSS of 2000 & 3500 mg/l**
- **Three different temperatures**
- **No change in soluble constituents**

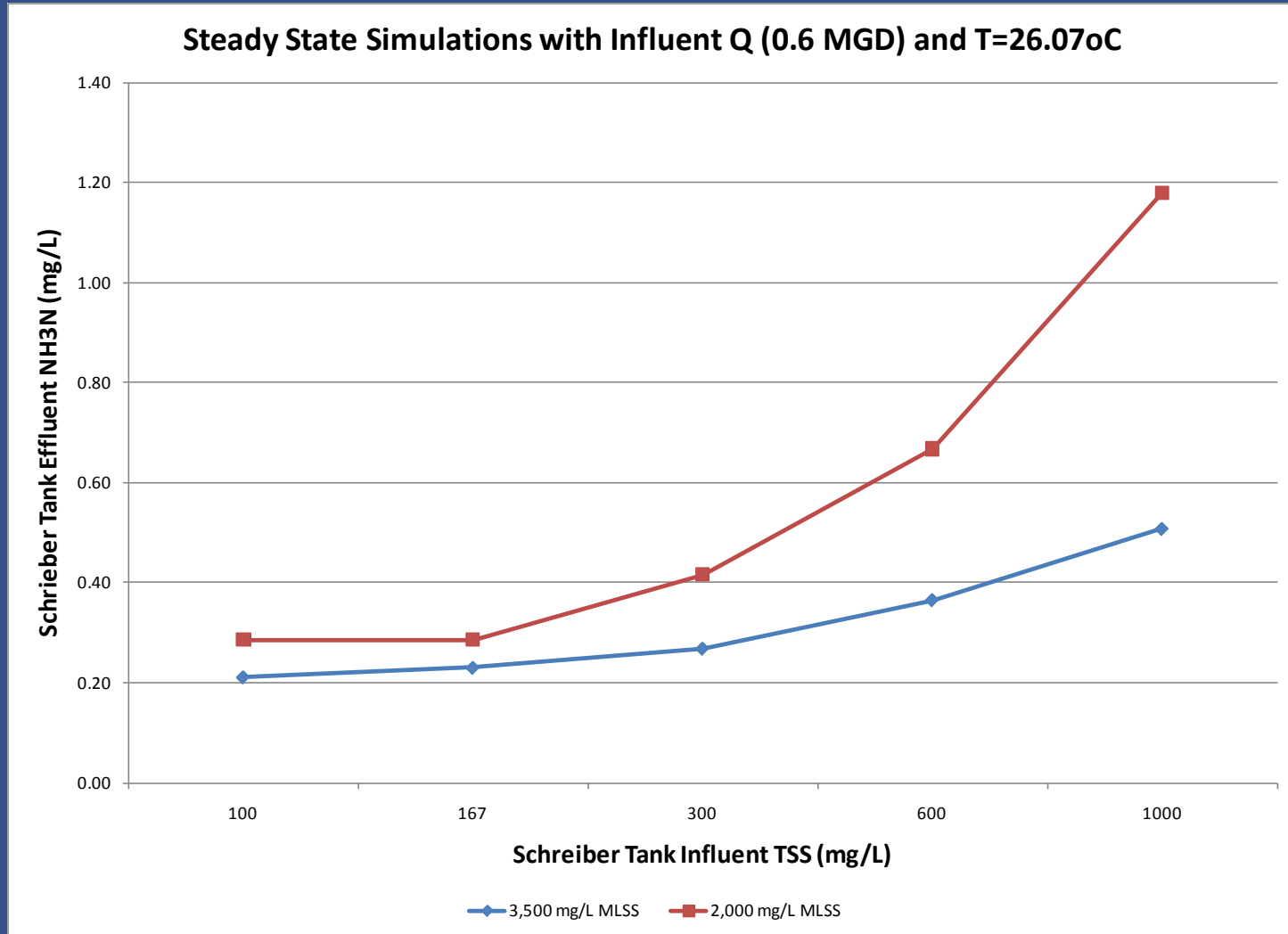
“Lagoon Solids” Results - Winter



“Lagoon Solids” Results - Average



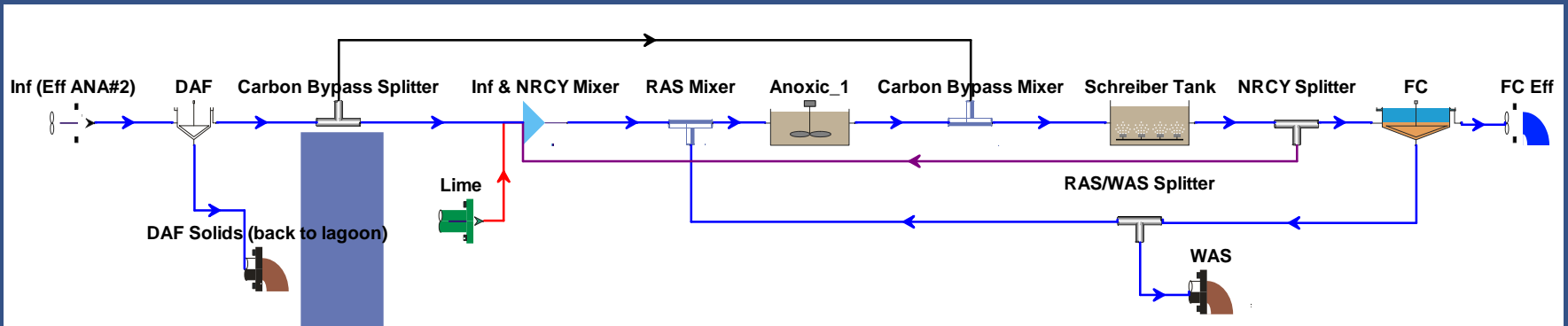
“Lagoon Solids” Results - Summer



Process Recommendations

- **Permanent DAF – effluent 100 mg/l TSS**
- **LSI control strategy**
- **Denitrification tank / WAS Storage**
 - Increase / recover alkalinity
 - Prevent “float”
- **Chemical feed / flocculation / splitter**
- **New settling tank**
- **NRCY / RAS Pump Station**

Reactor Sizing Simulations



- Added denitrification reactor to Biowin
- Added WAS
- Added RAS
- Added NRCY
- Added FC
- Added NO₃ reduction

Reactor Sizing - Effluent Nitrate

Anoxic Reactor Hydraulic Retention Time (based on $Q = 0.61$)	Simulated Effluent Nitrate Concentration (mg/l)
0 hrs (no anoxic zone)	185
4 hrs	120
6 hrs	93
8 hrs	79
16 hrs	59

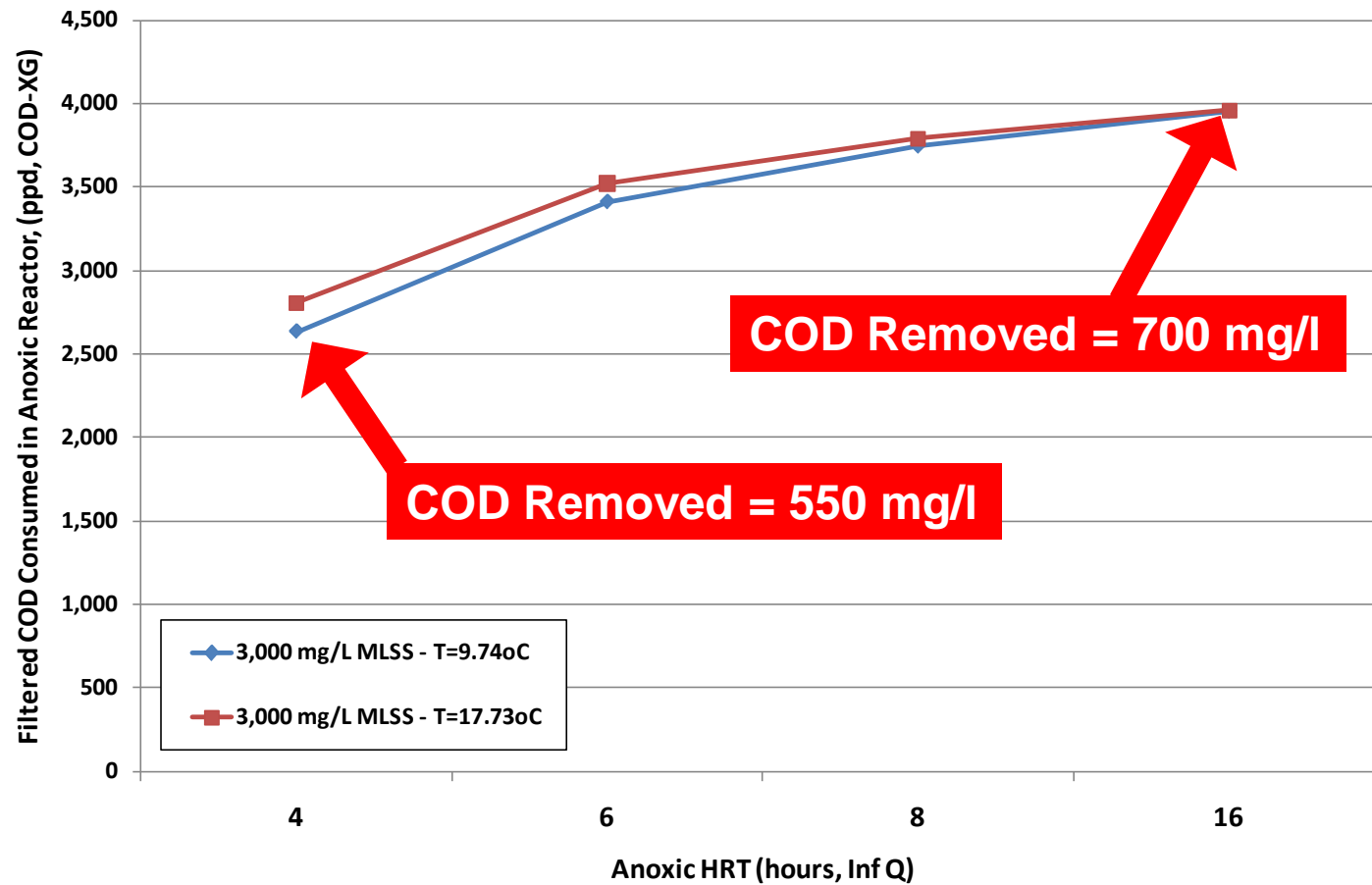
NOTES:

MLSS = 3000 mg/l

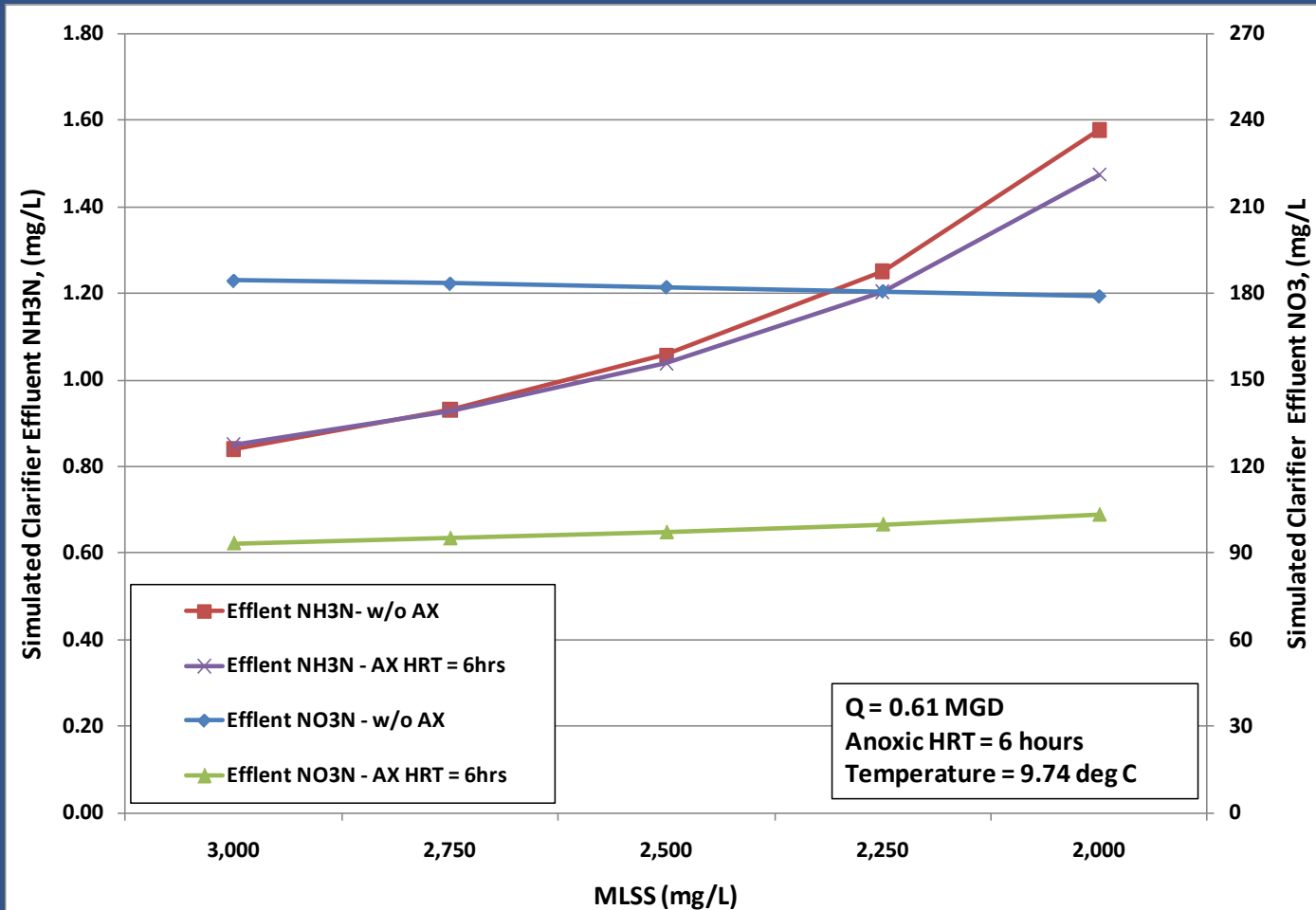
Temp = 9.74 deg C

Internal recycle rate of 300 % of influent flow rate

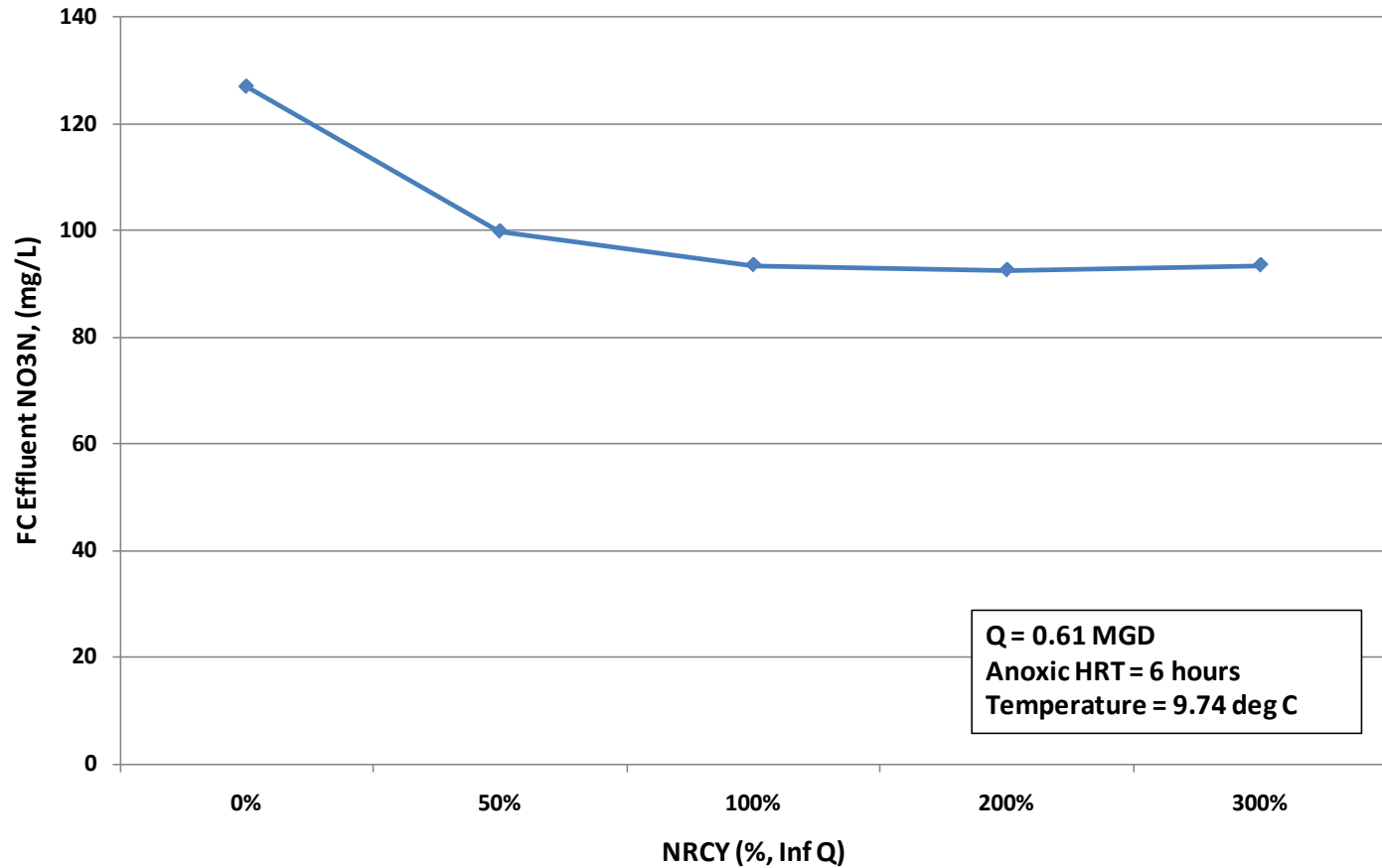
Reactor Sizing COD Consumption



Reactor Sizing – Effluent Ammonia



Reactor Sizing – Internal Recycle



Current Status

- Under construction
- Complete by 3/31/2011



Summary / Conclusions

- **Biowin useful as a tool in both troubleshooting and design**
 - Illustrative tool
 - Multiple simulations allows for process optimization
- **Effectiveness of model dependent on characterization**
- **Tailored to domestic, but can be “flexed” for industrial wastes and unique sidestreams**

Questions?

